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1958 NASA/USAF SPACE PROBES

(ABLE-1)

FINAL REPORT

VOLUME 4. CHARACTERISTICS OF THE ABLE-1 ENGINES

By Space Technology Laboratories, Inc.
Los Angeles 45, Calif.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON
June 1959

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Prepared for Air Force Ballistic Missile Division
Headquarters ARDC
Under Contract AF 04 (647)-205

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SPACE TECHNOLOGY LABORATORIES, INC.
P. O. Box 95001
Los Angeles 45, California

APPENDIX D

VOLUME 4. CHARACTERISTICS OF THE ABLE-1 ENGINES*

*For convenience the following four tables are classified and consequently have been issued separately.

Table 1. Stage 1 Thrust.

Fuel Density: 50.13 lb/cu ft

Nominal Mixture Ratio: 2.20

Time (sec)	Thrust (lb)	Specific Impulse (sec)	Flow Rate (lb sec)
0	152435	247.7	615.4
10	152717	248.7	614.06
20	154569	251.5	614.59
30	157632	256.3	615.03
40	161699	262.9	615.06
50	165628	270.4	612.53
60	169755	277.3	612.17
70	172811	282.8	611.07
80	174725	286.2	610.5
Head suppression of fuel line begins at t = 80 sec			
90	175454	287.3	610.7
100	175847	288.0	610.58
110	176088	288.4	610.57
120	176121	288.5	610.47
130	176115	288.5	610.45
140	176167	288.5	610.63
150	176248	288.5	610.91
158	176285	288.5	611.04

Nominal Engine Performance

	Thrust (lb)	Specific Impulse (sec)
Sea Level	152,000	248.0
Altitude	176,000	288.5

Table 2. Physical Characteristics and Nominal Performance of X-248A3 Motor.

Motor Designation:	X-248A3		
Manufacturer:	Allegheny Ballistics Laboratory		
Application:	Able 1 - Third Stage Motor		
Physical Characteristics			
Over-all length, inches			58.21 ±0.03
Diameter, inches			18.25 (max)
Initial weight, pounds			512.8
Propellant weight, pounds			455.9
Consumed weight, pounds			464.9*
Burnout weight, pounds			47.9*
Nozzle expansion ratio			26
Loaded moment of inertia, slug-ft^2:	Pitch		18.60
	Roll		4.26
Inert moment of inertia, slug-ft^2:	Pitch		2.55
	Roll		0.407
Center of gravity, inches (from nozzle exit):		Loaded	36.47
		Inert	23.21
Operating temperature range, ^{o}F			70 ±20
Igniter Information			
Squib Type			Two S11A2 squibs in parallel
Igniter resistance, ohms			1.12
Firing current, applied amps			3.2
Performance at 77^{o}F			
Ignition delay, seconds			0.04
Action time, seconds			37.5
Chamber pressure, psia			245
Altitude Thrust, pounds			3150
Altitude specific impulse, seconds			250.5*
Altitude total impulse, lb/sec			116,400 ±200
Thrust misalignment with respect to c.g., radian			±0.001

* Based on loss of 9 pounds of inert weight during firing.

Table 3. Physical Characteristics and Nominal Performance of the 1XS-50 Motor.

Motor Designation:	1XS-50
Manufacturer:	Atlantic Research Corporation
Application:	Able-1 Vernier and Spin Motor
Physical Characteristics:	
Over-all length, inches	4.80 ±0.05
Diameter, inches	1.532 ±0.003
Initial weight, pounds	0.60 ±0.05
Propellant weight, pounds	0.21
Burnout weight, pounds	0.39
Nozzle expansion ratio	22.4
Operating temperature range, ^{o}F	75 ±55
Igniter Information:	
Squib type	One standard Atlas Match M-103
Igniter resistance, ohm	1.4 ±0.1
Firing current applied, amp	3.0 (vernier)
	2.4 (spin)
Performance at 70^{o}F:	
Ignition delay, seconds	0.018
Action time, seconds	1.168
Chamber pressure, psia	600
Altitude thrust, pounds	45.6
Altitude specific impulse, seconds	250
Altitude total impulse, lb-sec	53.3

Table 4. Physical Characteristics and Nominal Performance of the TX8-6 Motor.

Motor Designation:	TX8-6
Manufacturer:	Thiokol Chemical Corporation
Application:	Able-1 Fourth Stage or Injection Rocket

Physical Characteristics:

Over-all length, inches	24.43
Diameter, inches	6.40
Initial weight, pounds	34.8
Propellant weight, pounds	24.0
Consumed weight, pounds	24.4
Burnout weight, pounds	10.4
Nozzle expansion ratio	10.0
Transverse mount of inertia, lb-in.^{2}	1443.1
Axial moment of inertia, lb-in.^{2}	208.0
Center of gravity, inches (from nozzle exit)	13.96
Operating temperature range, ^{o}F	80 ±20

Igniter Information:

Squib type	Two 207A squibs in parallel
Igniter resistance, ohm	0.12 ±0.03
Firing current applied, amp	10.0

Performance at 80^{o}F:

Ignition delay, seconds	0.007
Action time, seconds	7.0
Chamber pressure, psia	600
Altitude thrust, pounds	800
Altitude specific impulse, seconds	233*
Altitude total impulse, lb-sec	5690

*Based on loss of 0.4 pound of inert weight during firing.